

PETROLOGY, OR THE KNOWLEDGE OF ROCKS AND STONES.

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ALL kinds of rock decompose under atmospheric influences, the chemical and mechanical causes of decomposition varying in every region of the earth; all kinds of rock are produced by chemical and mechanical action. The evidence of their decomposition is continually before our eyes and requires no demonstration; but the forming action being local and not general, depending upon long and continuous atmospheric heat in particular regions, or taking place chemically within the bowels of the earth, is of necessity inaccessible to most men, and, therefore, requires demonstrable evidence to support it, until the truth becomes firmly established upon the conjoint evidence of observing men. Marbles form in most countries, being calcareous matter cemented together by siliceous, calcareous, or argillaceous earth; porphyry, sienite, gneiss, granites of varieties are produced under a continuous atmospheric heat, or by electro-chemical action, when the matter is disposed within the bowels of the earth or in mountainous districts. Slate rocks are produced from the induration of clay by mechanical pressure and cohesion, and by chemical change in the disposition of the particles of which they are composed. The stratified nature of these and also many of the crystalline rocks is another demonstrable proof that they are formed by sedimentary deposition of the earths.

Let any one examine the various stone quarries of this country, and he will most assuredly discover rock in almost every stage of formation, geologists will say in almost every stage of decomposition, but admitting this assertion, it gives a most decided negative to their notions of the primary nature of rocks. Again, the continued action of the atmosphere is evidently a condition of their assuming the perfect state of solidity, for many species degenerate as we dip into the earth, first losing their hardness, and eventually passing by transition into earths and clays. The lodging of water within the earth favours the conglomeration of silica and the generation of siliceous aggregates; and, uniting with the acids and salts abstracted by them from the mineral beds through which they percolate, or are conveyed by fissures and veins, they become the active agents of generation of various mineral bodies; thus sparry quartz is almost universally disposed in veins, and is the first crystalline product manifest in clay beds and in cavernous apertures of the earth; nay, sparry concretions are continually forming before our eyes, and walls and roofs of deserted mines soon become covered with them. The causes of effects manifest as quartz are therefore palpably existing in the present day, even in this country.

In the vast expanse of this planet, forming the middle regions of the earth, the sands, pebbles, mafis, and clays, are palpably produced by organic action, and the consequent changes of matter as it enters the fossil and mineral kingdom; in one region we find extensive ranges of carbonate of lime formed and still forming, intersected by vast ranges of sands, the causes of their production being still in active operation; in another we observe these primary earths covered with thick deposits of vegetable earth; in neither the one nor the other do we evidence their origin as proceeding from the decomposition of rocks, for in the first instance no species other than limestone rock is yet called into being, in the second, the very nature of the soil proclaims its origin, as the extent and magnitude of the tropical

vegetation bears evidence of its continuous increase.

As atmospheric and chemical influences and also mechanical action determine the nature, character, and qualities of rocks, so they also determine the changes they undergo after their primary formation from the earths aggregated by sedimentary deposition or elaborated by organic species. The sands which contributed to fill up the ancient canal of the Ptolemies, connecting the Red Sea with the Nile, have become agglutinated into very hard sandstone, which now conceals the original bed; on the other hand, the temple of Denderah, being built of a species of sandstone uniting with much lime, is rapidly decomposing; the nature of the cement which binds the sands together in one coherent mass always determines its powers of resistance to atmospheric influences. In many parts of Asia and Africa, in Australia and South America, porphyry, basalt, sienite, marbles, and varieties of crystalline rock form under long-continued atmospheric influences, and are apparently indestructible; in other regions of the globe they rapidly decay when they become exposed to atmospheric influences, or to the mechanical action of the winds and rains. The traveller, as he stands in the midst of the ruins of the magnificent temple at Luxor, observes that many of the granites and calcareous stones have rather improved their condition by age, becoming harder and more sonorous; others having a natural cement inimical to their preservation, have suffered partial or entire decomposition; the celebrated obelisks were very recently in a beautiful state of preservation, presenting the same, and most probably a higher state of finish than when turned out of the hand of the sculptor: gothic barbarism, led on by men of science, caused the removal of one of these obelisks to Paris, and its appearance among them was regarded as a national triumph. What is it now? a monument of the folly of the times in which we live, a reproach to civilized people, who for the sake of a childish triumph of national vanity, have broken the charm attached to it while surrounded by historical associations and revered relics of antiquity. In a few years, unless art can contend successfully against Time, this monument will be laid low in the dust.

On the shores of Great Britain the action of rolling beaches is exemplified in the waste and in the rounding of pebbles, and by giving them polished surfaces. Men seeing, and understanding these phenomena, carry their notions abroad, and wherever similar appearances present themselves, they suppose and maintain that the same causes have produced them; thus the first false link in the chain of induction being formed, they proceed to build their edifice thereon, cementing it together with theoretic fallacies and idle imaginings. In arid regions, where rains never fall, where the abrasion of waters has never taken place, the like phenomena are to be observed, vast plains being covered with rounded pebbles and polished surfaces; but here we have other causes of effects dissimilar to those observable in British strata; numerous species of mollusca in the act of silicifying lose their asperities, and become highly polished stones; echini, turtles' eggs, and other rounded bodies preserve their outer configuration through successive changes, and even aggregate masses, on consolidating into porphyritic and jasper bodies, assume that high polish which it is almost beyond the reach of art to imitate. Again, upon examining the crystalline rocks in this country, geologists find quartz to be the sole constituent of some species, and the chief ingredient of others; from these rocks they demonstrate the primary existence of quartz, and witnessing the corroding influences palpably manifest in this country and the mountainous districts of the Continent, they readily embrace the notions of M. Saussure and other geologists of the last century, contending for the generation of sands and pebbles by the desquamation of rocks; but the manifest phenomena of other regions carry us beyond the narrow boundaries prescribed by geology, developing the origin of quartz and of quartzose aggregates, as well as the origin of the earths from which, in aggregate, they are produced.

It has been observed by practical men that all species of rock belonging to this country exhibit greater durability as they approach the crystalline structure, but much depends upon the nature of the earth which forms the

cement of the crystalline particles as well as upon the nature of the local influences exercised upon it. Geologists speak of mosses and other vegetable species decomposing the rock on which they grow, and deriving therefrom the material of their organic structure; but the innumerable facts observable around us testify otherwise, for the rock or stone is no sooner covered with vegetation than the corrosion previously carried on over its exposed surface ceases, and ages may elapse without further sensible change. There is a proof of this adduced by the committee appointed to select the building material of the two Houses of Parliament; they found the frustra of columns and other blocks of stone that were quarried at the time of the erection of St. Paul's Cathedral, now lying in the island of Portland, near the quarries from whence they were obtained, coated entirely with lichens, and thus hermetically sealed from the atmosphere, presenting the same freshness as when first put out of hand, even to the chisel-marks, while the same stone forming the exterior of the cathedral exhibits in some places a considerable extent of decomposition.

The calcareous marles of all countries are dissimilar in their qualities, although the varieties have a close relationship to the material of the rocks and beds which overlie them; but these rocks, as I have previously observed, do not decompose until they become exposed to a humid atmosphere, or to the action of running streams. Thus, in the mountains of Abyssinia, of Lebanon and Arabia, there is a waste proportionable to the violence of the rains and running streams. Again, exposed to the action of the ocean waves, and even to the ocean breeze, the crystalline rock decomposes or corrodes; and monuments erected near the sea-coast, whatever may be the nature of their material, always suffer more or less from these causes, even in those regions that are most favourable for the forming of rock. Pompey's Pillar, standing near the old port of Alexandria, corrodes seaward, although composed of porphyry the most durable of all varieties of rock. Cleopatra's Needle exhibits the same effects, being corroded seaward, and maintaining its freshness of appearance on the two sides exposed to the hot, drying winds of the desert. The same phenomena may be observed in firs disposed near the sea-coast in all regions, the saline waters being inimical to most species of rock. In like manner, the rock soils forming deltas in tropical climates are equally unfavourable to every kind of stone, nay, even to the formation of stone, for the nitrous earths rapidly devour them all, and the rank luxuriance of these climates is such, that a village or town is no sooner deserted, than the very stones appear to vegetate, the poplar and other trees of rapid growth springing up from the crevices, and as their roots enlarge, the stones give way, splitting downwards, until the whole fabric is levelled to the dust. Even bricks in Bengal soon share the same fate, the nitrous salts being a component of them all.

The common gravel of England possesses neither beauty nor variety, its aggregates being generally of the nature of petrifications or flints. The stones of the Isle of Wight consist in bulk of aggregate of echini radiati, and the bodies or portions of bodies of varieties of species common to tropical seas, and of necessity produced under the same influences, being all of them in the silicified or mineralized state, and much of the British strata is composed of the like material, embracing the reliques of gigantic lizards and other extinct oceanic animals, together with the reliques of elephants, rhinoceroses, hippopotami, and other land animals, which can only exist and propagate in their generations under the conditions of a climate found within the tropics. The causes of these effects, which excite our wonder and stimulate our inquiries, I shall not under this head attempt to explain, but let us suppose another great change in the axis of rotation of the earth, whereby England is once more disposed beneath tropical influences; the sure and certain results would be an immediate change of action, and in the stomic disposition of many bodies: the clay beds would indurate into scabius or slate of varieties; the coarse gravels of this country would in numerous instances become converted into siliceous and aluminous gems; nay, the very rocks, in which the living principle exists, directing their